



## Sikorsky S-76 Accident Rates Show Overall Decrease

*Accident statistics for 1994 through 1997 show continued improvement in the helicopter's overall safety record, but also show an increase in accidents related to pilot error and controlled flight into terrain.*

—  
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A significant reduction of Sikorsky S-76 material-failure or maintenance-failure accidents contributed to improvement of the S-76's safety record in 1994 through 1997. Analysis of the recent accident data indicates that continued improvement of the S-76's — and other helicopters' — safety records will depend on reducing pilot-training accidents and controlled-flight-into-terrain (CFIT) accidents.

An earlier study found that the S-76 helicopter was involved in 3.59 accidents per 100,000 flight hours in 1980 through 1993.<sup>1</sup> There were 52 Class-A accidents in 1.45 million flight hours worldwide; 16 of the accidents were fatal. [See the definition of a Class-A accident on page 2.]

The U.S. National Transportation Safety Board (NTSB) said that there were 6.69 U.S.-registered turbine-helicopter accidents per 100,000 flight hours during the same period.

The worldwide fleet of S-76 helicopters flew 760,434 hours in 1994 through 1997. There were 13 Class-A accidents; the accident rate was 1.71 accidents per 100,000 flight hours. Seven accidents resulted in at least one fatality; the fatal accident rate was 0.92 per 100,000 flight hours. This is an



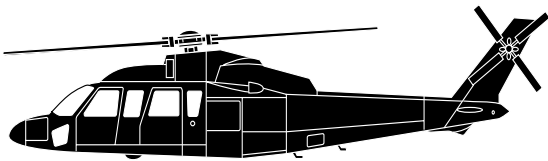
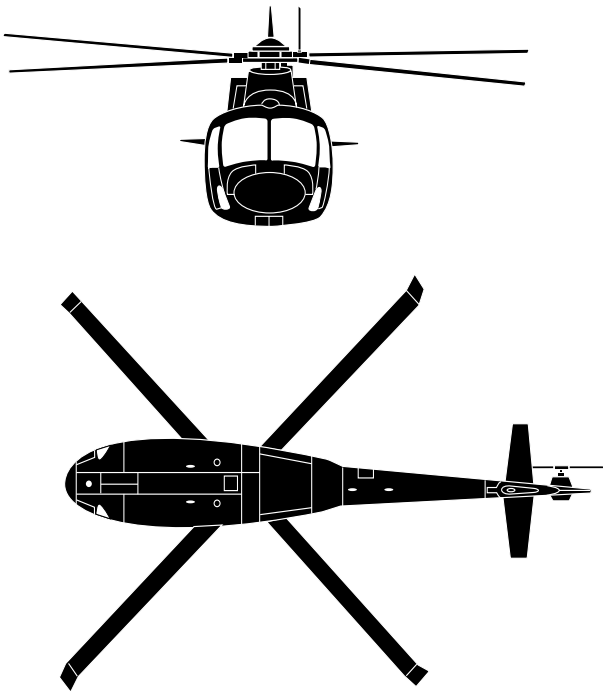
improvement compared to the rate of 1.10 fatal accidents per 100,000 flight hours in the earlier study period (1980 through 1993).

Figure 1 (page 2) compares the S-76 helicopter's worldwide accident rates for 1994 through 1997 with the accident rates for all U.S.-registered single-turbine-engine helicopters and twin-turbine-engine helicopters.

Figure 2 (page 2) compares the S-76 helicopter's worldwide accident rate for 1994 through 1997 with the accident rates of U.S. general-aviation aircraft, U.S. single-turbine-engine helicopters, U.S. twin-turbine-engine helicopters, U.S. Federal Aviation Regulations (FARs) nonscheduled Part 135 operations and scheduled Part 135 operations.

All data for this study were obtained from:

- Sikorsky Aircraft Corp. Class-A accident records;
- NTSB Aviation Accident/Incident Database;
- The 1996 U.S. Federal Aviation Administration (FAA) *Statistical Handbook of Aviation* (flight hours for 1997



### Sikorsky S-76

The Sikorsky S-76 first flew in 1977. The S-76A is configured to accommodate 12 passengers and two pilots. It has a maximum takeoff weight of 10,300 pounds (4,672 kilograms), a maximum cruising speed of 145 knots (268 kilometers per hour) and a service ceiling of 15,000 feet (4,575 meters). The S-76A has a maximum range of 404 nautical miles (748 kilometers) with 12 passengers, standard fuel and 30-minute reserve. The S-76A is powered by two Allison 250-C30 turboshaft engines, each rated at 650 shaft horsepower.

Source: *Jane's All the World's Aircraft*

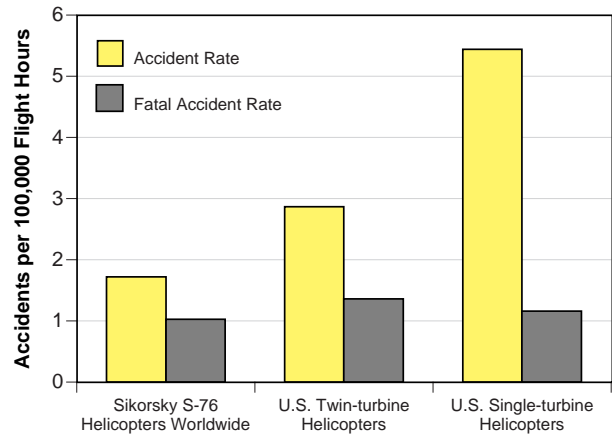
are the author's estimate based on the previous year's data); and,

- Air Data Research FAA Accident/Incident Database System.

Accident definitions are as follows:

- "Aircraft accident" is defined by NTSB as "an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft

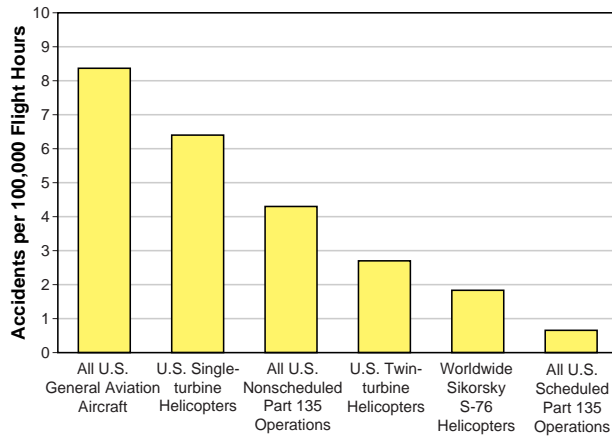
### Helicopter Accident Rates 1994–1997



Source: Joel S. Harris

Figure 1

### Aircraft Accident Rate Comparison 1994–1997



Source: Joel S. Harris

Figure 2

with the intention of flight and [until] all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage;" and,

- "Class-A accident" is defined by Sikorsky Aircraft Corp. of Stratford, Connecticut, U.S., as an accident resulting in a fatality or damage greater than US\$1 million.

(Sikorsky records include Class-A helicopter accidents that occurred in countries other than the United States. There may be some accidents in countries other than the United States that were not classified by Sikorsky as Class-A accidents, but which would have been classified by NTSB as aircraft

accidents. [The author believes that the differences in definitions do not alter significantly the statistics presented in this study or the earlier study.]

## Pilot-error Accident Rate Decreased

NTSB and/or Sikorsky determined that 11 (85 percent) of the 13 accidents in 1994 through 1997 resulted from pilot error. This compares with 51 percent of accidents attributed to pilot error in the earlier study.

The increased *percentage* of accidents attributed to pilot error does not mean that pilots are making more mistakes when operating S-76 helicopters. The *rate* of pilot-error accidents actually has decreased. There were 1.7 pilot-error accidents per 100,000 flight hours in 1980 through 1993, compared with 1.5 pilot-error accidents per 100,000 flight hours in 1994 through 1997.

Figure 3 shows the accident rates, fatal-accident rates and pilot-error-accident rates for the two study periods.

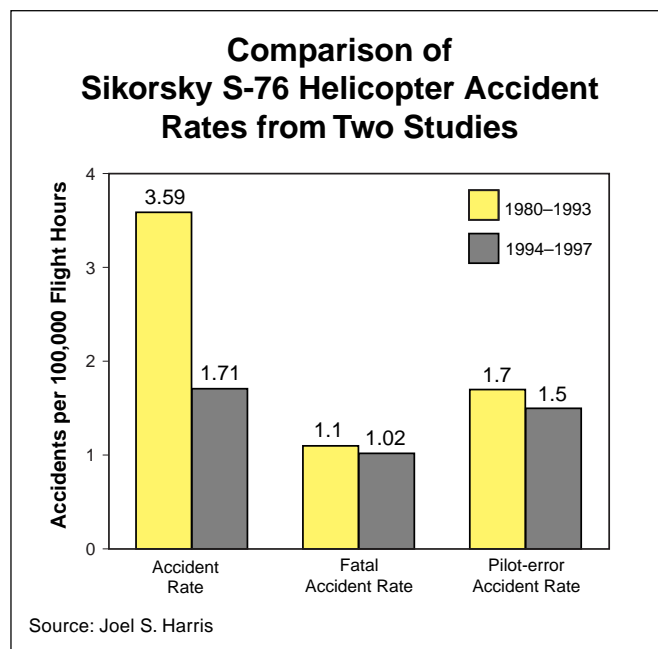


Figure 3

The increase in the percentage of pilot-error accidents is caused, in part, by a decrease in accidents that resulted from material failure or maintenance failure. Nearly one-third of the accidents in the earlier study resulted from either material failure or maintenance failure. Only one of the 13 accidents in 1994 through 1997 resulted from material failure; none of the accidents was attributed to maintenance failure.

[The material-failure helicopter accident resulted from partial failure of the transmission while the helicopter was cruising 500 feet (152 meters) over water at dusk; this was

the only failure of this type in more than 2.4 million flight hours.

NTSB said, “A vibration, followed by a loud bang, occurred. The main-gearbox chip light illuminated, and the number-one engine dropped off line. A forced landing was initiated, the emergency floats were inflated and a ditching to water was accomplished.”

Timely and correct action by the pilots prevented any injuries and resulted in minimal damage to the aircraft. Extended exposure to salt water after the June 30, 1994, accident resulted in additional damage, however.]

[The other helicopter accident not attributed to pilot error involved a hoist cable that snagged while the helicopter was lifting a medical patient from a ship off the coast of Spain on Aug. 26, 1995.]

“Each generation [of aircraft] has had a high[er] accident rate immediately following introduction into service than in later years of service,” said Stuart Matthews, chairman, president and CEO of Flight Safety Foundation, in discussing the relative safety of newer-generation aircraft.

The S-76, which has been in service since 1980, is no exception. Figure 4 shows that the helicopter’s accident rate has diminished.

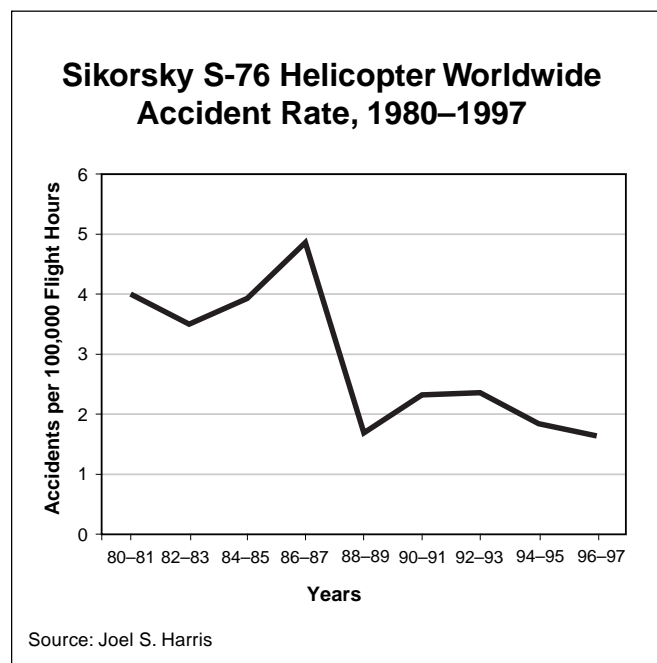


Figure 4

## CFIT Involved in Pilot-error Accidents

More than half (six) of the 11 pilot-error accidents may have involved controlled flight into terrain. A CFIT accident occurs when an otherwise serviceable aircraft under the control of

the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness of the crew of the impending collision.

During the period 1959 to 1996, CFIT was responsible for more than 50 percent of all commercial aviation fatalities.

One of the six possible helicopter CFIT accidents occurred in the Gulf of Mexico during an instrument approach to Cameron, Louisiana, U.S., on Nov. 8, 1994.<sup>3</sup>

The other possible helicopter CFIT accidents include:

- A helicopter that struck terrain while flying in adverse weather conditions on a mountainous island off the coast of China on April 9, 1996;
- A helicopter that struck a ridge in Ireland during an instrument-training flight in adverse weather conditions on Dec. 12, 1996;
- A helicopter that struck a ridge 198 feet (60 meters) below the crest in South Korea on April 29, 1997;
- A helicopter that was taking off in adverse weather conditions in the United States on Sept. 22, 1997; and,
- A helicopter that flew into the North Sea while approaching an offshore structure in low-visibility conditions on Dec. 21, 1997.

All of the aircraft were being operated by two-pilot crews, and in each accident the flight crew apparently was unaware that the helicopter was about to strike terrain or water. The majority of these possible CFIT accidents — and the majority (10 of 13) of all the S-76 accidents during the study period — occurred outside the United States. Twenty-two of the 52 accidents in the previous study occurred outside the United States.

Approximately 420 S-76 helicopters are in operation worldwide. About 38 percent (159) of the helicopters are registered in the United States. Figure 5 shows the distribution of the fleet.

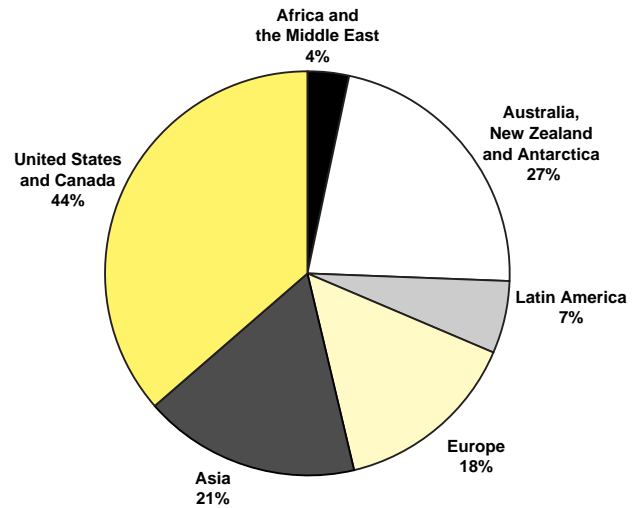
Table 1 shows the distribution of S-76 accidents during the previous and present study periods.

### Training and Understanding Cultural Factors Prevent Accidents

As worldwide use of the S-76 increases, adequate training of flight crews will be necessary to maintain the helicopter's relatively good safety record.

Crew resource management (CRM) training is used extensively in the United States to reduce commercial and corporate aircraft-accident rates. Flight crews are taught how to work

### Sikorsky S-76 Helicopter-fleet Distribution



Source: Joel S. Harris

Figure 5

Table 1  
Number of Sikorsky S-76 Helicopter Accidents

Area	1980 –1993	1994–1997	Total
Africa and the Middle East	1	0	1
Asia	11	5	16
Australia, New Zealand and Antarctica	0	0	0
Europe	5	3	8
Latin America	4	1	5
United States and Canada	31	4	35
<b>Total</b>	<b>52</b>	<b>13</b>	<b>65</b>

Source: Joel S. Harris

together, to communicate more effectively and to make better decisions.

When U.S. flight crews study decision-making techniques, they are trained to gather information from all sources, and they are encouraged to maintain a cockpit environment in which subordinate flight crewmembers share the responsibility for making decisions with the pilot-in-command.

Crewmembers are trained that even the most junior member has the right — and the obligation — to communicate assertively any doubts or concerns about the conduct or safety of the flight.

Nevertheless, the type of CRM training conducted in the United States may not be suitable in other countries. Robert L. Helmreich, Ph.D., and associates at the University of Texas (Austin, Texas, U.S.) have studied the effects of national culture on aviation training and operations.

“The cultural differences that we have observed suggest that approaches to CRM training that work well in one culture may not be positively received elsewhere,” said Helmreich and associates Ashleigh C. Merritt and Paul J. Sherman. “For example, training that presents a basic requirement for first officers to be more assertive with their captains may be met with incredulity by members of cultures that do not endorse such direct or egalitarian communication.”<sup>4</sup>

As more S-76 helicopters begin operations outside the United States, pilot-training institutions will need to find ways to adapt CRM training to different national cultures.

## Two Accidents Occurred During Training

Two of the S-76 accidents in 1994 through 1997 occurred during training. One occurred during an instrument training flight; the other accident occurred during training in engine-failure procedures.

[During the first five months of 1998, two additional S-76 training accidents have occurred. One occurred when an S-76 collided with a ship during a practice night-rescue mission in Japan on Feb. 20, 1998. The other accident was a possible CFIT that occurred on Feb. 22, 1998; the S-76 helicopter accident occurred on an island off the coast of China during an instrument flight rules (IFR) training flight.]

Jim Spillman, director of training at FlightSafety International’s West Palm Beach (Florida, U.S.) Learning Center, said, “Training can be an especially vulnerable time for accidents. However, carefully thought-out and strictly enforced training policies and procedures can help reduce the likelihood of accidents during training flights.

“For example, IFR [instrument flight rules] training flights conducted in actual [instrument meteorological] conditions

should always include a qualified and current IFR captain. Night VFR [visual flight rules] training missions should include increased weather minimums and never should be done in marginal weather conditions. By imposing these types of common-sense limits on training, many future training accidents can be avoided.”

The Sikorsky S-76 helicopter has an excellent safety record. From 1980 through 1993, the S-76’s safety record compared favorably with the safety records of other turbine helicopters. In 1994 through 1997, the helicopter’s accident rate decreased by half. Nevertheless, pilots, operators and training professionals must work to eliminate CFIT and training accidents.♦

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## About the Author

*Joel S. Harris has an airline-transport-pilot certificate and a flight-instructor certificate with ratings in helicopters and airplanes. He is a U.S. Federal Aviation Administration designated pilot-proficiency examiner, Federal Aviation Regulations Part 135 check airman and safety counselor. He is Southeast U.S. regional director of pilot standards for FlightSafety International and is based at FSI’s West Palm Beach Learning Center. He has administered more than 10,000 hours of flight, simulator and ground-school training to professional helicopter pilots.*

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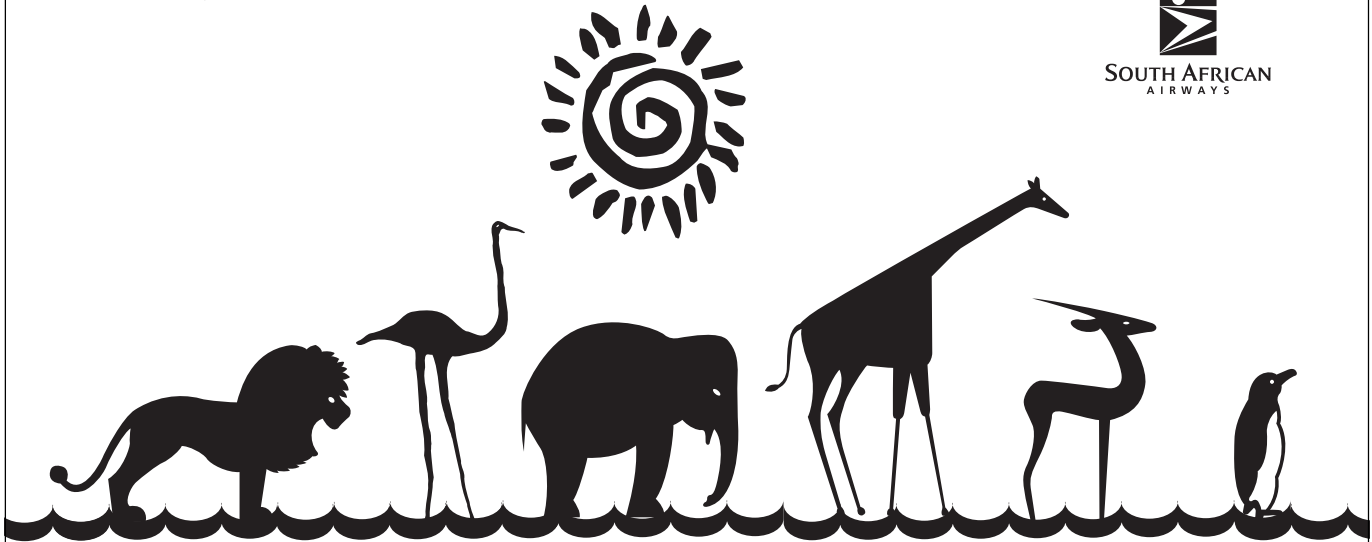
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